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AUTOMOTIVE DIESEL MAINTENANCE. PROGRAM OUTLINE.
HUMAN ENGINEERING INSTITUTE, CLEVELAND, OHIO

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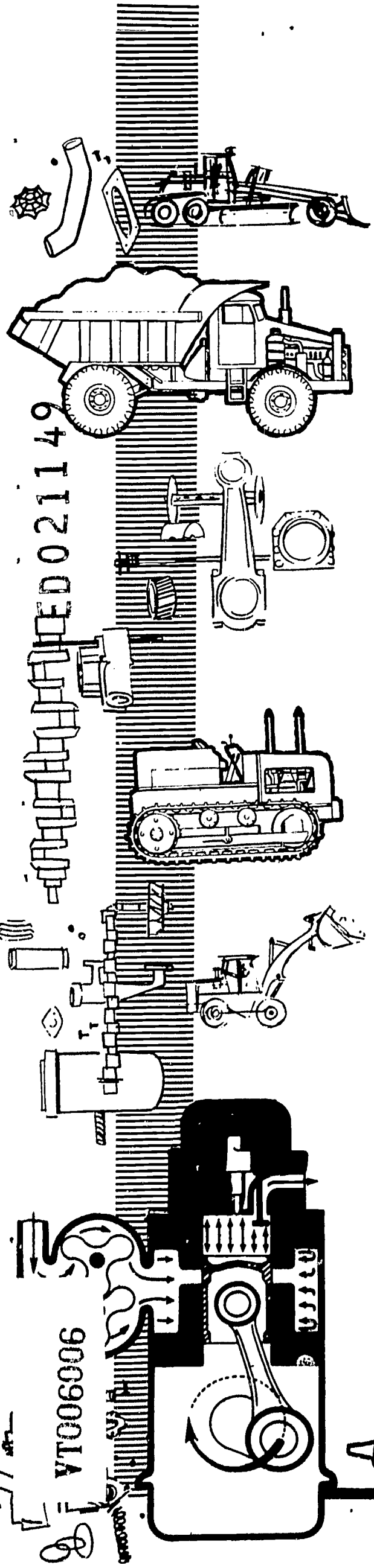
DESCRIPTORS- *CURRICULUM GUIDES, *TRADE AND INDUSTRIAL EDUCATION, MOTOR VEHICLES, *AUTO MECHANICS (OCCUPATION), *DIESEL ENGINES, ADULT VOCATIONAL EDUCATION, TRANSPARENCIES, PROGRAMED MATERIALS, INDIVIDUAL INSTRUCTION, INSTRUCTIONAL FILMS, PROGRAMED INSTRUCTION, EQUIPMENT MAINTENANCE,

INFORMATIONAL TOPICS COVERED IN THE TEXT MATERIALS AND SELF-INSTRUCTIONAL BRANCH PROGRAMED TRAINING FILMS FOR A 2-YEAR, 55 MODULE PROGRAM IN AUTOMOTIVE DIESEL MAINTENANCE ARE GIVEN. THE 30 MODULES FOR "AUTOMOTIVE DIESEL MAINTENANCE 1" ARE AVAILABLE AS VT 005 655 - VT 005 684, AND THE 25 MODULES FOR "AUTOMOTIVE DIESEL MAINTENANCE 2" ARE AVAILABLE AS VT 005 685 - VT 005 709. THIS DOCUMENT IS AVAILABLE FROM THE HUMAN ENGINEERING INSTITUTE, HEADQUARTERS AND DEVELOPMENT CENTER, 2341 CARNEGIE AVENUE, CLEVELAND, OHIO 44115. (HC)



STUDY AND READING MATERIALS

AUTOMOTIVE DIESEL MAINTENANCE

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

PROGRAM OUTLINE

HUMAN ENGINEERING INSTITUTE

AUTOMOTIVE MAINTENANCE -- YEAR I

	Text	Individualized Instruction With Didactor
AM 1-1	GENERAL INTRODUCTION TO DIESEL ENGINES A. Diesel engines vs gasoline engines B. Air supply for the diesel C. Fuel supply for the diesel D. Lubricating the diesel E. Cooling the diesel F. Advantages of diesels G. Mechanical features	DIESEL AUTOMOTIVE MAINTENANCE -- GENERAL INTRODUCTION Diesel engine vs gas engine -- similar components -- compression differences -- fuels -- safety -- advantages/disadvantages -- two cycle vs four cycle -- Roots blower (basic) -- air turbulence -- combustion chamber shapes
AM 1-2	MAINTAINING THE AIR SYSTEM -- DETROIT DIESEL ENGINES A. Operation and function B. The air cleaner: oil bath cleaner and dry type cleaner C. Air shutdown housing D. Exhaust system E. The blower F. The turbocharger G. Troubleshooting tips on the air system	DIESEL AUTOMOTIVE MAINTENANCE -- DETROIT DIESEL AIR SYSTEM Concept of air in relation to solids/liquids -- atmospheric pressure -- psi -- sea level vs altitude -- vacuum -- manometer -- psig -- absolute pressure -- air and the diesel -- air and the blower -- exhaust back pressure -- testing with a manometer
AM 1-3	MAINTAINING THE FUEL SYSTEM -- DETROIT DIESEL ENGINES A. Purpose of the fuel system B. Tracing the fuel flow C. Minor components of the fuel system D. Maintenance tips E. Construction and function of the fuel injectors F. Troubleshooting tips	MAINTAINING THE FUEL SYSTEM -- DETROIT DIESEL Basic characteristics of fuel -- cetane numbers -- viscosity -- distillation -- sulfur content -- fuel specifications -- diesel fuel specifications -- abnormal engine performance due to fuel

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AM 1-4	MAINTAINING THE COOLING SYSTEM -- DETROIT DIESEL ENGINES A. Purpose of cooling system B. Care and maintenance of the cooling system C. Cooling system components D. Troubleshooting tips	DIESEL AUTOMOTIVE MAINTENANCE -- HEAT TRANSFER Principles of heat transfer -- convection -- conduction -- radiation -- heat dissipation -- thermal conductivity -- heat dissipation in diesel engines
AM 1-5	MAINTAINING THE LUBRICATION SYSTEM -- DETROIT DIESEL ENGINES A. Lube oils used B. Maintenance of the lubrication system C. Crankcase ventilation components	BASIC ENGINE LUBRICANT CHARACTERISTICS Lubricant deterioration in diesels -- oxidation -- organic acids -- varnish -- sludge -- chemical characteristics of oil -- additives -- viscosity -- detergents -- SAE designation -- Conradson test
AM 1-6	MAINTAINING MECHANICAL GOVERNORS -- DETROIT DIESEL ENGINES A. Types of governors and engine location B. Governor applications C. Limiting speed mechanical governor (in-line and V-71 series) D. Variable speed mechanical governor (in-line and V-71 series) E. Constant speed mechanical governor (in-line 71)	MECHANICAL PRINCIPLES OF GOVERNOR OPERATION Centrifugal force of governor flyweights -- spring tension -- decreased loads -- increased loads -- fuel control -- fulcrums -- pivots -- mechanical advantage -- governor failures
AM 1-7	ENGINE TUNE-UP: DETROIT DIESEL ENGINES A. Scheduling tune-ups B. Tune-up procedures	ENGINE TUNE-UP--DETROIT DIESEL ENGINE When a tune-up is required -- temperature of engine and tune-up -- importance of sequence -- exhaust valve clearance -- timing the fuel injectors -- governor gap -- injector rack -- maximum no-load speed -- idle speed -- adjusting the buffer screw -- linkage and throttle movement

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AM 1-8	ENGINE COMPONENTS -- PART I A. Cylinder assembly (liners) B. Cylinder head C. Valves and valve mechanisms D. Piston and piston rings	ENGINE COMPONENTS -- PART I Combustion -- ignition -- air-fuel ratios -- ignition delay -- turbulence -- temperatures -- fuel qualities -- smoke analysis
AM 1-9	ENGINE COMPONENTS -- PART II A. Shafts and bearings B. Camshafts C. Bearings and their maintenance D. Detecting failure	ENGINE COMPONENTS -- PART II Bearings and the diesel engine -- thrust -- radial loads -- axial loads -- journal bearings -- friction -- heat dissipation -- crankshaft bearing loads for two cycle engines -- bearing loads for four cycle engines -- ball bearings -- needle bearings -- roller bearings -- care of bearings
AM 1-10	USE OF MEASURING TOOLS IN DIESEL MAINTENANCE A. Linear measure B. Measuring with rules and tapes C. Getting precision with micrometers D. Dial indicators E. Tachometers F. Torque wrench G. Thickness (feeler) gage H. Valve repair equipment	USE OF MEASURING TOOLS IN DIESEL MAINTENANCE Tools and the diesel mechanic -- shop math -- micrometers (inside, outside, depth) -- reading micrometers -- problems
AM 1-11	PART I - MAINTAINING THE FUEL SYSTEM -- CUMMINS DIESEL ENGINES (part 1) A. Review of two cycle and four cycle concept B. Some basic characteristics of four cycle engines C. The Cummins fuel system PART II - UNIT REPLACEMENT (ENGINE) A. Preparation for removal B. Unit removal	UNDERSTANDING BASIC HYDRAULICS IN RELATION TO CUMMINS FUEL PUMPS Pumps and the change from mechanical energy into pressure energy -- volumetric output -- positive displacement -- non-positive displacement -- rotary -- reciprocating -- propelier pumps -- mixed flow pumps -- turbocharger

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AM 1-12	PART I - MAINTAINING THE FUEL SYSTEM -- CUMMINS DIESEL ENGINES (part 2) A. Fuel flow characteristics B. PTG fuel pump PART II - UNIT INSTALLATION (ENGINE) A. Preparation for installation B. Installing engine	PRINCIPLES OF TORCH CUTTING Chemistry and the torch -- definitions -- terms -- oxidation and the air -- oxyacetylene cutting -- carburizing flame -- neutral flame -- excess oxygen flame -- excess acetylene flame
AM 1-13	PART I - MAINTAINING THE FUEL SYSTEM -- CUMMINS DIESEL ENGINES (part 3) A. More about the Cummins fuel system B. Calibrating the PT fuel pump C. Calibrating the fuel injectors PART II - RADIATOR SHUTTER SYSTEM A. Understanding the shutter system B. The shutter C. Shutter control cylinder D. Shutter control valve E. Air filters	OPERATION OF THE CUMMINS PT FUEL SYSTEM COMPONENTS PTG vs PTR -- fuel manifold pressure -- engine torque -- bypass holes -- four strokes of the four cycle engine -- governor operation at different speeds -- colors and governor spring strength -- aneroid control
AM 1-14	PART I - MAINTAINING THE AIR SYSTEM -- CUMMINS DIESEL ENGINES A. Definition of terms related to the diesel air system B. Principles of diesel air compressors C. Principles of air starting motors D. Servicing Cummins starting motors PART II - UNIT REMOVAL -- TRANSMISSION A. Preparation for removal B. Unit removal	UNDERSTANDING THE DIESEL AIR SYSTEM. Valves and actuating gear in relation to flow of air and exhaust gases -- valve timing -- function of the heat exchanger on turbocharged engines -- altitudes and turbo-chargers -- naturally aspirated engines -- extreme cold vs oxygen content of air

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AM 1-15	PART I - MAINTAINING THE COOLING SYSTEM -- CUMMINS DIESEL ENGINES A. Importance of the cooling system B. Cooling system components C. Evaluating cooling system failures D. Caring for the cooling system PART II - UNIT INSTALLATION -- TRANSMISSION A. Preparation for installation B. Installing transmission	PRINCIPLES OF DIESEL ENGINE COOLING SYSTEMS Review of GM and Cummins cooling systems -- pressurized cooling -- radiator and the by-pass tube -- thermostats and variations in temperature -- Withnell radiators -- cold weather and the cooling system -- pump cavitation (implosion)
AM 1-16	PART I - USE AND CARE OF SMALL HAND TOOLS A. Understanding torque and how it is measured B. Repairing and replacing threaded fasteners PART II - PRINCIPLES OF THE POWER DIVIDER A. Understanding the operating principles B. Power divider removal from truck	PRINCIPLES AND APPLICATIONS OF BASIC MACHINES Breaking down the complex machine into smaller and simpler machines -- levers -- pulleys -- wheel and axle -- inclined plane -- screws and wedges -- terms (work, power and energy) -- horsepower defined mathematically -- mechanical advantage problems
AM 1-17	PART I - MAINTAINING THE LUBRICATION SYSTEM -- CUMMINS DIESEL ENGINES A. Prolonging engine life B. Functions of the lubricating system C. Tracing the lubricant flow D. Determining lubrication system failures E. Maintaining lubrication system components F. Learning about oil tests G. Field testing of oil PART II - UNIT INSTALLATION AND REMOVAL -- DRIVE LINES A. Drive line description B. Removal of drive line C. Troubleshooting	UNDERSTANDING DIESEL ENGINE LUBRICATION SYSTEMS Crankcase sludge, its content and where it is found in the engine -- causes of sludge -- low temperature sludge -- high temperature sludge -- fuel soot -- blow-by -- the expansion of aluminum heads and temperature variations -- types of oil filters

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AM 1-18	PART I - UNDERSTANDING ENGINE GEARS AND GEARING PRINCIPLES A. The purpose of engine gears B. Inspecting for gear failures C. Inspecting for shaft failures D. Using snap rings to position gears or bearings PART II - MACK INTER-AXLE POWER DIVIDER A. Operating principles B. Repairing the Mack power divider	UNDERSTANDING GEARS AND GEAR RATIOS Principles of driver and driven gears -- shafts -- direction of rotation -- idler gears -- gear ratios -- gear speed -- speed ratio -- types of gears -- keys and keyways
AM 1-19	PART I - ENGINE TUNE-UP -- CUMMINS DIESEL ENGINES A. Pre tune-up checks B. Timing the engine C. Injector plunger and valve adjustments D. Fuel pump adjustments on the engine (PTR and PTG) PART II - FRONT END SUSPENSION AND AXLES A. History of front axles B. Axle loads	PRINCIPLES OF TUNE-UP -- CUMMINS DIESEL ENGINE Fuel injection and top dead center (TDC) -- retarded/advanced -- early injection and fuel knock -- push rod adjustment -- camshaft gear adjustment -- valve adjustment -- fuel pump adjustment -- vacuum gauge readings -- shims and the fuel pump
AM 1-20	CUMMINS DIESEL ENGINE MAINTENANCE SUMMARY A. What engine break-in means B. Engine break-in C. Torquing bearings (template method) D. The need for maintenance	CUMMINS DIESEL ENGINE MAINTENANCE SUMMARY Review of diesel engine oil consumption -- piston rings -- cylinder liner finishes -- contours of mating surfaces -- engine break-in period -- template method of torquing bearings -- safety precautions

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AM 1-21	PART I - MAINTAINING THE AIR SYSTEM -- CATERPILLAR DIESEL ENGINES A. Air induction and exhaust system B. Valve mechanism C. Troubleshooting the air system PART II - UNDERSTANDING REAR END SUSPENSION A. Purpose of vehicle suspension B. Tandem drive axle suspension C. Compressed nitrogen cylinder suspension system	MAINTAINING THE AIR INTAKE AND EXHAUST SYSTEMS -- CATERPILLAR DIESEL ENGINE Comparison of CAT air system to GM and Cummins -- air pressure ratio control regulator -- turbo-charger speed control -- hot exhaust from the poney engine -- after-cooling -- air cleaners -- valve rotors -- overhead cam-shafts -- priority valve
AM 1-22	PART I - MAINTAINING THE FUEL SYSTEM -- CATER-PILLAR DIESEL ENGINES (part 1) A. Fuel system comparisons B. Fuel system supply com-ponents C. Fuel supply section main-tenance PART II - UNDERSTANDING THE DIFFERENTIAL A. Function of the differential B. Construction of the differential C. Differential removal	UNDERSTANDING THE CATERPILLAR FUEL SYSTEM Multi-cylinder type fuel pump -- priming pump -- high pressure fuel lines -- fuel metered and pressurized -- inside the fuel pump -- rack limiter -- speed limiter -- troubleshooting the CAT fuel system
AM 1-23	PART I - MAINTAINING THE FUEL SYSTEM -- CATERPILLAR DIESEL ENGINES (part 2) A. Fuel injection section PART II - UNDERSTANDING STEERING SYSTEMS A. Description of the steering system	UNDERSTANDING THE CATERPILLAR FUEL SYSTEM Multi-cylinder type fuel pump -- priming pump -- high pressure fuel lines -- fuel metered and pressurized -- inside the fuel pump -- rack limiter -- speed limiter -- troubleshooting the CAT fuel system

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AM 1-24	PART I - MAINTAINING THE FUEL SYSTEM -- CATERPILLAR DIESEL ENGINES (part 3) A. Injection timing controls B. Governor C. Fuel system maintenance tips PART II - UNDERSTANDING THE VOLTAGE REGULATOR/ ALTERNATOR A. The charging system B. Regulating the generator/ alternator C. Charging system service precautions	UNDERSTANDING THE CATERPILLAR FUEL SYSTEM Multi-cylinder type fuel pump -- priming pump -- high pressure fuel lines -- fuel metered and pressurized -- inside the fuel pump -- rack limiter -- speed limiter -- troubleshooting the CAT fuel system
AM 1-25	PART I - CATERPILLAR DIESEL ENGINE COOLING SYSTEM D-8 AND 824 MODELS A. Theory of the cooling system B. Cooling system components C. Maintenance tips PART II - TIRES AND TIRE HARDWARE A. General description B. Liquid filled tires C. Tire maintenance D. Prolonging tire life	CATERPILLAR DIESEL ENGINE COOLING SYSTEM Review of diesel engine cooling systems -- radiation -- circulation -- absorption -- scale deposits and hot spots -- adding water to hot engines -- trouble-shooting the cooling system
AM 1-26	PART I - CATERPILLAR LUBRICATION SYSTEMS AND COMPONENTS A. The need for oil B. Service classification of oils C. Caterpillar lubrication system components PART II - LEARNING ABOUT BRAKES (part 1) A. Principle of operation (friction) B. Brake friction principle C. Brake control system D. Inspection of brakes	CATERPILLAR LUBRICATION SYSTEMS AND COMPONENTS Functions of oil in a diesel engine -- additives -- oil fluidity -- viscosimeter -- multiple viscosity ranges -- Series 3 oils -- CAT oil pump -- detergents in oil

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AM 1-27	PART I - CATERPILLAR STARTING (PONEY) ENGINE (part 1) A. General description B. Operation C. Combustion space and valve arrangement (starting engines) PART II - LEARNING ABOUT BRAKES (part 2) A. Types of brakes B. Double actuated drum brakes	CATERPILLAR DIESEL STARTING ENGINE Function of the CAT poney engine -- starting mechanism (magneto) -- lubrication system -- exhaust manifold and the diesel engine -- carburetor -- overrunning clutch -- spark plug science -- combustion chamber -- detonation -- electrical fundamentals and the magneto
AM 1-28	PART I - CATERPILLAR STARTING (PONEY) ENGINE (part 2) A. Starting engine magneto (WICO) B. Magneto maintenance C. Spark plugs PART II - UNDERSTANDING MORE ABOUT STARTING DEVICES A. General description B. Operation C. Lubrication D. Periodic checks and adjustments E. Cranking motor drive checks	CATERPILLAR DIESEL STARTING ENGINE Function of the CAT poney engine -- starting mechanism (magneto) -- lubrication system -- exhaust manifold and the diesel engine -- carburetor -- overrunning clutch -- spark plug science -- combustion chamber -- detonation -- electrical fundamentals and the magneto
AM 1-29	REVIEWING THE CONSTRUCTION OF ENGINE COMPONENTS A. Stationary parts B. Engine moving parts C. Piston rings D. Connecting rods and piston pins	NONE REQUIRED

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AM 1-30	PART I - CATERPILLAR DIESEL ENGINE MAINTENANCE SUMMARY A. Troubleshooting the engine on 988, 824 and 834 CAT loaders and dozers B. Troubleshooting the Caterpillar D8 engine C. Troubleshooting the Caterpillar starting engine D. Removing the starting engine from a Caterpillar 824 tractor E. Troubleshooting the Caterpillar No. 12 motor grader PART II - REVIEWING FACTS ABOUT ALTERNATORS A. Operation of the alternator B. Alternator testing and adjusting	SUMMARIZING CATERPILLAR ENGINES This film lesson reviews the previous nine units by asking questions about their content. Troubleshooting questions about the air, fuel, lubrication and cooling systems of the CAT engine are restated and answered where missed.

AUTOMOTIVE MAINTENANCE -- YEAR II

	Text	Individualized Instruction With Didactor
AM 2-1	UNDERSTANDING MECHANICAL CLUTCHES A. Power from the engine -- then what? B. Types of clutches C. Component parts of the clutch D. Clutch adjustment and troubleshooting	LEARNING ABOUT MECHANICAL CLUTCHES Purpose of mechanical clutches -- clutch construction -- engagement and disengagement -- hydraulic clutch operating principles -- clutch adjustment and trouble-shooting -- clutch slippage -- clutch noise -- torque -- foot-pound vs pound-foot -- lever principles as they apply to gears and gearing -- gear ratios
AM 2-2	MECHANICAL TRANSMISSIONS A. Purpose of transmissions B. Ratio difference C. Constant mesh transmission D. Four-speed truck transmission power flow E. Transmission trouble-shooting	UNDERSTANDING MECHANICAL TRANSMISSIONS Purpose of transmissions -- torque vs speed -- measuring torque -- gear reduction principles -- mechanical advantage -- calculating mechanical advantage of gear, wheel and axle arrangements -- changing speed and direction with gears -- magnifying force with gears -- constant mesh transmissions
AM 2-3	AUTOMATIC TRANSMISSIONS -- HYDRAULICS (PART I) A. Why use hydraulics B. Reviewing basic physics laws in relation to hydraulics C. Understanding the hydraulic system D. Developing a basic hydraulic system	BASIC HYDRAULICS Basic laws of physics concerning pressure, work, power -- liquid characteristics -- Pascal's Law -- mechanical advantage -- kinetic energy and heat energy -- laminar and turbulent flow -- friction -- Bernoulli's principle

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AM 2-4	AUTOMATIC TRANSMISSIONS -- HYDRAULICS (PART II) A. Reviewing facts about pumps B. Using valves for control C. Troubleshooting procedures on relief valves D. Using directional control valves E. Flow control valves	UNDERSTANDING DIRECTIONAL CONTROL VALVES Purpose and uses of directional control valves -- directional control check valves -- pilot operated check valves -- position valves -- spool valves -- manually operated and pilot operated four way valves -- pilot chokes -- shuttle valves -- electrically operated hydraulic circuits -- solenoid controlled, pilot operated valves -- rotary directional valves -- troubleshooting directional valves -- effects of dirt and heat -- back pressure -- internal leakage -- detent valves
AM 2-5	AUTOMATIC TRANSMISSIONS -- TORQUE CONVERTER A. Fluid couplings (location and purpose) B. Principle of operation C. Torque converters D. Torqmatic converter E. Three stage, three element torque converter F. Torque converter maintenance and troubleshooting	LEARNING ABOUT TORQUE CONVERTERS Construction and operation of fluid couplings -- fluid flywheel couplings -- construction and operation of torque converters -- fluid couplings vs torque converters -- converter oil flow patterns -- kinetic energy -- rotary flow and vortex flow -- two phase converter operation -- Torqmatic retarder (brake) -- maintenance and troubleshooting -- maintenance intervals -- oil changing -- converter stall -- causes of power loss

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AM 2-6	AUTOMATIC TRANSMISSIONS -- PLANETARY GEARING A. Purpose of planetary gearing B. Power transmission through a planetary system C. Hydramatic transmission D. Hydraulic system E. Gear failure and lubrication	UNDERSTANDING PLANETARY GEARING IN RELATION TO AUTOMATIC TRANSMISSIONS Construction of planetary gear systems -- sun gear -- planetary pinions -- ring gear -- planetary carrier -- obtaining minimum and maximum gear reduction with planetary gears -- minimum and maximum overdrive -- planetary gearing in a hydra-matic transmission -- gear failure and lubrication -- other causes of gear failure -- pitting -- metal fatigue -- normal wear
AM 2-7	AUTOMATIC TRANSMISSIONS - ALLISON TORQMATIC SERIES 5960 AND 6060 (PART I) A. General specification data B. Options for various applications C. Road test instructions D. Identification and specification data E. Allison TC-500 series converter F. Converter hydraulic system G. Maintaining the converter	NO FILM REQUIRED
AM 2-8	AUTOMATIC TRANSMISSIONS - ALLISON TORQMATIC SERIES 5960, 6060 and 8860 (PART II) A. General description B. Optional equipment C. Transmission power flow (splitter section) D. Transmission power flow (range section) E. Inspection and maintenance F. Troubleshooting the transmission	LEARNING ABOUT THE ALLISON TORQMATIC HYDRAULIC SYSTEM (PART I) Driving combination oil pressure and scavenge pump -- oil filters -- signal switch -- main pressure valve -- lockup shift valve -- intermediate range clutch trimmer valve -- fluid velocity (pitot) governor -- converter pressure regulator and relief valve -- converter bypass valve -- converter-in check valve -- neutral signal trimmer valve

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AM 2-9	AUTOMATIC TRANSMISSIONS -- HYDRAULIC SYSTEM (PART I) A. General description B. Hydraulic circuits C. Brake hydraulic circuit and operation	LEARNING ABOUT THE ALLISON TORQMATIC HYDRAULIC SYSTEM (PART II) Neutral range hydraulic action -- first range hydraulic action -- second range hydraulic action -- third range hydraulic action -- fourth range hydraulic action -- fifth range hydraulic action -- sixth range hydraulic action -- reverse range hydraulic action -- lockup shift valve and clutch -- review of basic operating principles
AM 2-10	AUTOMATIC TRANSMISSIONS -- HYDRAULIC SYSTEM (PART II) A. Checking the hydraulic system B. Servicing the hydraulic system C. Examining the range control valve D. Examining the lockup and flow valve E. Examining the main regulator valve F. Examining the brake valve G. Dual path transmission principle	SUMMARIZING MECHANICAL AND AUTOMATIC TRANSMISSIONS Review of mechanical clutch operating principles -- purpose of clutch -- mechanical clutch troubleshooting -- clutch noise -- review of mechanical and automatic transmission operating principles -- idler gears -- minimum and maximum gear reduction and overdrive -- reverse reduction -- review of fluid couplings -- converter maintenance -- changing oil and filters -- converter stall -- loss of power

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AM 2-11	INTRODUCTION TO ELECTRICAL MAINTENANCE FOR OFF-HIGHWAY VEHICLES A. Fundamentals of electricity and magnetism B. Electromagnetic fields C. Magnetic force on a conductor D. Electromagnetic induction E. Ohm's Law F. Meter movements G. Glossary of terms	UNDERSTANDING THE FUNDAMENTALS OF ELECTRICITY AND MAGNETISM Elements and compounds -- atoms and molecules -- protons, electrons and neutrons -- electron movement -- conductors and non-conductors -- amperage, voltage and resistance in relation to electron flow -- principles of magnetism -- basic law of magnetism -- polarity -- principles of electromagnetism -- Current Theory vs Electron Theory -- right hand rule -- electromagnetic fields -- electromagnetic induction
AM 2-12	LEARNING ABOUT BATTERY SERVICING AND TESTING (PART I) A. Battery components and construction B. Chemical action in batteries C. The battery and the charging circuit D. Battery charging voltage E. Effects of state of charge on battery charging voltage and charging rates F. Effects of temperature on battery charging voltage and charging rates G. Terminology	AUTOMOTIVE BATTERIES I -- INTRODUCTION TO THE LEAD-ACID STORAGE BATTERY Basic functions of lead-acid storage battery -- construction of lead-acid storage batteries -- grids and plates -- positive plates -- negative plates -- plate groups -- cell packs -- development of voltage in lead-acid storage batteries -- vent caps -- electrolyte -- specific gravity -- changes in the battery plates during charge and discharge -- gassing -- charging voltage vs CEMF and IR_b -- state of charge and charging voltage -- temperature and charging voltage and rate -- voltage regulators

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AM 2-13	BATTERY SERVICE AND TESTING PROCEDURES (PART II) A. Electrolyte and specific gravity B. Battery charging C. Storage battery types and design D. Battery capacity ratings E. Battery installation, servicing and testing F. Factors affecting battery life G. Safety precautions	AUTOMOTIVE BATTERIES II -- BATTERY SERVICING AND TESTING PROCEDURES Storing lead-acid storage battery -- wet charged batteries vs dry charged batteries -- self-discharge -- battery installation and removal -- test for proper battery installation -- visual inspection -- condition and size of battery cables -- using hydrometer to measure electrolyte specific gravity -- hydrometer test interpretation -- electrolyte temperature correction -- voltmeter tests -- light load test and interpretation -- battery operation and performance in low temperature areas
AM 2-14	UNDERSTANDING DC GENERATOR PRINCIPLES (PART I) A. What is a generator and its use? B. Shunt generator principles C. Power and ratings of a generator D. Armature reaction E. What is polarity? F. Two generator circuits G. Application of generators on the job	DC GENERATORS I -- INTRODUCTION TO DC GENERATOR PRINCIPLES Electromagnetic induction -- producing current in a conductor moving through a stationary field -- construction and operation of DC generator -- speed of armature rotation vs generator output -- number of armature turns vs generator output -- strength of the field vs generator output -- armature reaction and brush positioning -- mechanical neutral and load neutral positions -- generator power and ratings -- voltage and current ratings -- eddy currents -- construction and operation of voltage regulator and current regulator -- identifying "A" circuit and "B" circuit systems

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AM 2-15	UNDERSTANDING DC GENERATOR PRINCIPLES (PART II) A. Special generator circuits B. Generator testing C. Generator polarity and polarizing procedures	DC GENERATORS II -- GENERATOR TESTING PROCEDURES Construction and operation of cutout relay -- cutout relay adjustment -- effect of current direction on two adjacent coils -- identifying "A" and "B" circuits at the generator and at the regulator -- four types of electrical malfunctions: shorts, opens, grounds, high resistance -- tests for high resistance -- visual inspection and trouble-shooting -- testing field circuit and armature for grounds, opens, shorts -- polarizing "A" circuit and "B" circuit generators
AM 2-16	LEARNING ABOUT AC GENERATOR (ALTERNATOR) PRINCIPLES (PART I) A. Reviewing electrical fundamentals B. Operating principles of alternators	AC GENERATORS I -- UNDERSTANDING ALTERNATOR PRINCIPLES Electromagnetic induction -- producing current in stationary conductor by means of rotating magnetic field -- construction and operation of AC generator (alternator) -- rotor, stator and rectifier assemblies -- producing AC in stator windings -- positive diodes, negative diodes and their functions -- current flow in the three phase stator assembly

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AM 2-17	LEARNING ABOUT AC GENERATOR (ALTERNATOR) PRINCIPLES (PART II) A. Review of alternator principles B. Alternator servicing and testing C. Alternator regulator operating principles D. Periodic regulator servicing and general troubleshooting of the charging system	AC GENERATORS II -- REGULATOR AND FIELD RELAY OPERATING PRINCIPLES and ALTERNATOR TESTING Construction and operation of alternator regulator -- three unit alternator regulators -- construction and operation of field relay unit -- introduction to alternator testing -- abnormal battery condition as a symptom of electrical system trouble -- alternator field winding tests for opens, shorts, grounds -- stator winding tests for opens and grounds -- diode service precautions -- diode tests using low voltage test lamps or ohmmeter
AM 2-18	ALTERNATOR AND REGULATOR SERVICING AND TESTING, AND AN INTRODUCTION TO TRANSISTOR REGULATORS A. Review of generator principles, AC and DC B. Servicing and testing alternators C. Introduction to transistor regulators	INTRODUCTION TO TRANSISTORS and TRANSISTOR CONTROLLED AND TRANSISTORIZED REGULATORS Transistor vs contact points -- semiconductors -- doping -- N type and P type semiconductor materials -- PN junction -- forward and reverse bias connections -- transistor operation -- transistorized regulators -- transistor controlled regulators -- using transistors to control alternator field current -- alternator output test -- regulator tests for transistorized and transistor controlled regulators

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AM 2-19	LEARNING ABOUT CRANKING MOTORS A. Cranking motors B. Motor principles C. Cranking motor circuits D. Types of cranking motor drives E. Cranking motor solenoid circuits	LEARNING ABOUT CRANKING MOTORS Construction and operation of cranking motors -- drive mechanisms -- electromagnetism and cranking motors -- cranking motor solenoid circuits -- Dyer drive cranking motors -- troubleshooting and adjustment -- Bendix type drive
AM 2-20	TROUBLESHOOTING ELECTRICAL SYSTEMS A. Troubleshooting electrical systems (introduction) B. Tools and instruments for troubleshooting C. The battery D. Periodic battery servicing E. The DC charging system F. Periodic regulator servicing G. The wiring circuit H. General troubleshooting of the charging system I. The AC charging system J. The cranking system (electrical) K. General troubleshooting of the cranking system	TROUBLESHOOTING ELECTRICAL SYSTEMS (INTRODUCTION TO BASIC AND GENERAL PROCEDURES) "On-the-vehicle" inspection and servicing -- battery checks as part of inspection and troubleshooting -- using the voltmeter -- using the ammeter -- using the ohmmeter -- "A" and "B" circuits -- polarizing -- generator servicing: armature and brushes -- regulator servicing: contact points -- troubleshooting the charging system -- alternator charging systems -- troubleshooting the cranking system
AM 2-21	MICHIGAN/CLARK TRANSMISSION -- COMPLETE POWER TRAIN A. Examining the power flow B. Unit oil flow C. Oil pressure in the converter and transmission system	UNDERSTANDING THE MICHIGAN/CLARK POWER TRAIN Construction and operation of the torque converter -- lubrication of the converter and transmission -- oil flow through the converter and transmission system -- function of the transmission -- manual shift control valve -- maintaining the transmission

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AM 2-22	MICHIGAN/CLARK TRANSMISSION -- CONVERTER/TRANSMISSION A. A closer look at the converter B. Converter assembly and installation C. Transmission function D. Transmission shifting	MICHIGAN/CLARK TRANSMISSION -- TRANSMISSION AND CONVERTER FUNCTION Function of converter -- function of transmission -- function of gear box -- speed clutches -- range clutches -- direction clutches -- maintaining oil pressure in the converter/transmission -- converter stall -- function of oil cooler
AM 2-23	MICHIGAN/CLARK TRANSMISSION -- HYDRAULIC SHIFT A. Mechanical and hydraulic shifting B. Oil flow through the control valve	MICHIGAN/CLARK TRANSMISSION -- MECHANICAL AND HYDRAULIC SHIFT and OIL FLOW THROUGH THE VALVES AND CONTROL COVER ASSEMBLY Function of directional shift and speed range levers -- function of shift control valve -- oil flow through supply hoses, control valve and transmission control cover -- oil flow through supply hoses in the various speed ranges -- function of accumulator, microswitch, declutch valve and directional spool
AM 2-24	MICHIGAN/CLARK TRANSMISSION -- OIL FLOW THROUGH THE CONTROL COVER ASSEMBLY A. Examining the control cover assembly B. Regulating valve and safety valve C. Inspecting the system	MICHIGAN/CLARK TRANSMISSION -- MECHANICAL AND HYDRAULIC SHIFT and OIL FLOW THROUGH THE VALVES AND CONTROL COVER ASSEMBLY Function of directional shift and speed range levers -- function of shift control valve -- oil flow through supply hoses, control valve and transmission control cover -- oil flow through supply hoses in the various speed ranges -- function of accumulator, microswitch, declutch valve and directional spool

	Text	Individualized Instruction With Didactor
AM 2-25	MICHIGAN/CLARK TRANSMISSION -- TROUBLESHOOTING A. Preliminary checks B. Pressure and oil flow checks C. Troubleshooting tables D. Troubleshooting vehicles under field conditions E. Analyzing unacceptable inspection results	MICHIGAN/CLARK TRANSMISSION -- TROUBLESHOOTING The components as parts of a system -- mechanical and hydraulic checks as part of a troubleshooting procedure -- introduction to pressure and flow rate checks -- hydraulic checks at converter-in, converter-out, charging pump -- transmission clutch pressure and leakage checks -- lube flow and converter leakage checks -- review of check points for hydraulic checks